"INCIDENCE, BACTERIOLOGY AND SCORING OF POST-OPERATIVE WOUND SEPSIS".

THESIS

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C E R T I F I C A T E

This is to certify that the work entitled "INCIDENCE, BACTERIOLOGY AND SCORING OF POST-OPERATIVE WOUND SEPSIS", which is being submitted as Thesis for M.S.(General Surgery) Examination 1992 of Bundelkhand University, Jhansi, has been carried out by Dr. Neeta Sehgal herself in this Department.

She has put in the necessary stay in the department as required by the regulation of Bundelkhand University.

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C E R T I F I C A T E

This is to certify that the present work entitled "INCIDENCE, BACTERIOLOGY AND SCORING OF POST-OPERATIVE WOUND SEPSIS", which is being submitted as Thesis for M.S.(General Surgery) Examination 1992, has been carried out by Dr. Neeta Sehgal, under my constant supervision and guidance. The results and observations were checked and verified by me from time to time. The techniques embodied in this work were undertaken by the candidate herself.

This work fulfils the basic ordinance governing the submission of thesis laid down by Bundelkhand University.

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C E R T I F I C A T E

This is to certify that Dr. Meeta Sehgal has worked on ' INCIDENCE, BACTERIOLOGY AND SCORING OF POST-OPERATIVE WOUND SEPSIS ', under my guidance and supervision.

Her results and observations have been checked and verified by me from time to time.

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Dated : 10th Aug. 1991.

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C O N T E N T S

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INTRODUCTION

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Infection is a dynamic process involving invasion of the body by pathogenic micro organism and reaction of the tissues to organisms and their toxins. Soon after birth, a variety of micro organisms colonise the external and internal surface of human body. This indigenous microflora usually does no harm, it produces no detectable pathological effects in tissues and even may be beneficial. Infection evolves into overt disease only when the equilibrium between host and parasite is upset. Of the thousands of species of micro organisms in nature, only few hundred are known to be pathogenic for human beings.

Current thinking concerning clinical disease resulting from host and parasite inter-relationships recognises the role of general health of the host, the previous contact with micro-organisms, the past clinical history and various insults (toxic, traumatic and therapeutic) of non-microbial origin.

Despite more than 80 years of aseptic surgery and more than 40 years of experience with anti-microbial agents, the surgeons finds that infections are as great problem now as in the past. But the etiologic agents have changed.

Streptococci and pneumococci are no longer the captains of death because they can be controlled by antibiotics.

Staphylococci continue to cause nosocomial (hospital acquired) infections, but those gram negative bacteria usually considered non-pathogens opportunists or secondary invaders have become a major problem. Nosocomial infections result from transmission of pathogens to a previously uninfected patient from a source in the hospital environment (cross infection). Alternatively the pathogens may come from patients themselves (auto-infections). They may be carriers of the pathogens or become colonized with virulent hospital strains during hospitalisation. Many nosocomial infections have iatrogenic basis. Frequent or prolonged use of supportive procedures such as indwelling vascular or urinary catheters, tracheostomies, equipment for post-operative respiratory care are responsible for most iatrogenic infections.

A surgical infection (42) is an infection that required surgical treatment and has developed before or as a complication of surgical treatment. Thus a post-operative wound infection is also a specific nosocomial infection. Surgical infections may be analysed in relations to procedures in clean or contaminated field, the anatomic site or system involved and the pathophysiologic activities of the causative micro-organisms.

The micro-organisms commonly encountered in surgical infections are the staphylococci, streptococci, clostridia, bacteroids, E. coli, pseudomonas, Proteus and Klebsiella.

It is frequently said with some truth that you cannot begin to investigate something until you can measure it. There is no doubt for instance that the clinical study of accidental trauma has greatly dependant on the various attempts to grade its severity (21, 22). You can measure severity of Head injury by glasgow comma scale but as far as sepsis is concerned, a convenient grading system is still lacking. Sepsis can be present in so many forms e.g. just a local wound infection or generalised involvement of all the systems of body. However, attempts have been made by some workers to evaluate a system for grading the severity of sepsis but the different parameters used in these system were not easily obtainable. In between these two extremes, other forms of presentation of sepsis also exists, but you can't measure them. So in this study, we have attempted to grade the sepsis by modified grading system of I.A. Kinsbute & H.B. Stoner (17).

AIM OF STUDY

The present study is aimed at -

1. Finding the incidence of post-operative wound infection.
2. Type of bacteria involved.
3. Grading the severity of sepsis by modified scoring system of I.A. Klebute & H.B. Stoner (17).

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REVIEW OF LITERATURE

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Innovation in the treatment of disease by surgical therapy has been apparent since the beginning of recorded history. By the time anaesthesia was introduced by Martin in 1846, numerous operations were practiced. Though after anaesthesia was widely used and surgeons could operate more deliberately, yet elective operations remained an unacceptable alternative for most patients with surgical disease, because almost all operative wounds become infected and almost half of all patients who had a major operation died as a result of infection. The most frequent complications of wound were erysipelas, hospital gangrene (presumably necrotising streptococcal mixed synergistic infection), septicaemia and/or tetanus. Infection was so common in wounds that it was thought by many, an important part of the normal healing process.

Lister has been generally recognised as the discoverer of the antiseptic surgery and his paper on the "Antiseptic Principle in the Practice of Surgery" published in 1867 was instrumental in revolutionising the practice of Surgery, the infection rate in elective operations dropped from 90% or more to 10% or less with application of Listerian principles (15). Lister was

guided and stimulated by the work of Pasteur on the nature of fermentation and purifications and his contributions related well to the observations and work of many men such as Oliver Wendell Holmes, Ignaz Semmelweis and Theodor Kocher. Even though many others preceding Lister helped pave the way, Lister's concept and techniques met with widespread disbelief during the latter part of the 19th century and were resisted. However, the superior results could not be ignored too long, and the concepts of asepsis as pioneered by Semmelweiss in 1847 and antisepsis as pioneered by Lister in 1867 gradually amalgamed so that aseptic antiseptic principles were almost completely developed by 1890 and have been the concept without change during 20th century.

It was these basic principles of infection control set forth primarily in the 33 years between 1867 and 1900 that really set surgery free from the bonds of despair and disappointment, changing surgical therapy from a dreaded event of infection with almost a sure death to one that now provides an enormous alleviation of suffering and prolongation of the life with close to universal success when carefully performed.

In 1955 there was a general impression that post-operative wound sepsis was becoming more common. This belief was probably based on reports of outbreaks of exceptional severity with sepsis rate between 10% and 37%.

In 1960 Public Health Laboratories Service (37) conducted a study to give information on the incidence of wound sepsis and its cost in terms of loss of life and length of stay in hospitals in England & Wales. Patients included in this study were all whose operation involved an incision through healthy skin. Operations on lower urinary tracts, rectum or anus and on accidental wounds were excluded. On the day of admission, a nose swab was taken from each patient and was cultured for staph aureus. During the post-operative period the wound was examined at the time of the first dressing. Swabs were taken from nearly all wounds at the time of first dressing.

A total of 3276 surgical operations in twenty one different hospitals were studied clinically and (in 2860) bacteriologically. During convalescence, 9.7% of wounds were affected by some post-operative sepsis and yielded pathogenic bacteria on culture. The sepsis rate in different hospitals undertaking general surgery varied between 4.7% & 21.8%. The highest sepsis rate after clean operations were for cholecystectomy (21%) and breast carcinoma (15%) and lowest were for orthopaedic operations (2%).

Greater age of the patients, length of pre-operative stay in hospital, length of incision and duration of operation were all associated with increased sepsis rate as was the use of a drainage tube. Staph aureus

was the commonest pathogen but infection with coliform organism was also common. Nasal carriers of staph aureus had only a slightly higher post-operative sepsis rate than non-carrier 68.9% compared with 71%. Patients whose wounds healed without sepsis left hospital on average .8 days earlier than had been predicted on the day of operation, than with sepsis and infection had an excess of 7.3 days over that predicted. 58 of the patients in the survey died, but in only 1 case was death definitely attributed to wound sepsis.

In 1960 Lawrence S. Cohen (13) et al studied the epidemiology of staphylococcal infection. All patients admitted to the ward surgical service of The Johns Hopkins hospital between September 1960 and December 1961 were studied. A clinical infection was defined as a lesion characterized by suppuration or cellulitis and from which coagulase positive staphylococcus aureus was isolated predominantly or in pure culture. During this study, 8952 surgical procedures were performed, 143 post-operative staphylococcal infections were diagnosed and the infection rate was 16%. Nearly all the post-operative infections were wound infections. Three patients had infection at the sites of indwelling intravenous catheters. The highest infection rates were seen after operations upon the gastro-intestinal tract, gastrectomy, cholecystectomy, lysis of abdominal adhesions, drainage of abdominal abscess,

oesophageal operations, colon resections and abdomino-perineal resection had rates in success of 5%. Increasing age of the patient, increasing duration of operation, the use of blood transfusions, hypotension necessitating the use of vasopressor amines during operation and congestive cardiac failure were correlated with an increased infection rate. Race, sex, the need for an emergency operation, the presence of a drain post-operatively, prophylactic antibiotics, diabetes, chronic lung disease, uraemia, cancer, obesity, liver disease, steroid therapy and length of time spent in hospital before operation were not correlated with increased susceptibility in infection.

In 1962 John A.S. Stewart & D.M. Douglas (46) studied the relationship between wound sepsis and operating list order. During a period of twenty seven months, a wound register was kept in a general surgical unit. The records included information about the position of each case on the operating list, the nature and duration of each operation, the length and drainage of wounds and the state of each wound whether clean or septic. In the cases with incised wounds the duration of operation was recorded as long as if it lasted more than sixty minutes, medium if thirty to sixty minutes, or short if less than thirty minutes. Wound length was similarly recorded as long if more than 20 cms, medium if 10 - 20 cms, or short if less than 10 cm. Drains were recorded if present and

these included some inserted through the main access wound and others inserted through a separate stab wound. Analysis of data was carried out in respect of several factors said to be associated with high wound sepsis rate. Wound sepsis was present in 11 of 595 cases - 1.8%. There was a significantly low sepsis rate in cases placed first on the operating list. However, when combined analysis in respect of duration of operation, wound length and wound drainage was done. It showed that case first on the list were in each instance, at a disadvantage with significantly longer operation, long wounds and more drain than later. There was a significantly high sepsis rate of 13.8% in young children less than 1 year old. The overall position in respect of wound sepsis rates showed an increase with late positioning in operating list. The association might be the result of artefact, fatigue and operating theatre contamination. No association could be demonstrated in clean cases between sepsis rate and duration of operation, wound length or drainage or advanced age.

In 1964, Committee on Trauma (14) published a report on post-operative wound infection and the influence of u.v. irradiation of the operating room and of the various other factors. It was investigated by means of a double blind randomised study in five institutions. Over a two year period, 14,854 operations and 15,613 incisions were studied in relation to post-operative wound infection.

Although u.v. radiation reduced the number of air-borne bacteria in the operating room, the wound infection rate in the entire series following operation was 7.4% in irradiated rooms and 7.5% in non-irradiated rooms. The only category of wounds that benefited significantly from the use of u.v. radiation was the refined clean group in which post-operative infection rate was reduced from 3.0 to 2.9%. The overall infection rates at each of the five participating hospitals varied from a low of 3 to high of 11.7%. The age of the patient apparently exerts a direct influence on wound infection rate which rises steadily from 15-24 years of age-group to 65-74 years of age-group.

Diabetic patients showed no increased susceptibility to infection. The extremely obese patients appear to be more susceptible to wound infection.

In 1967, A.J. Henderson (23) conducted a study to know the extent of staphylococcal infection of surgical wounds. One hundred clean operations were studied over a period of 3 years. They were all major operations e.g. radical mastectomies (59), cholecystectomies (31) and gastrectomies (2). The remainder 8 were miscellaneous. Ninty one of the hundred operations were drained by a tube through a stab wound, separate from the main incision. The operations were all performed by same Surgeons. The patients were examined daily until either the wound had

healed and the stitches were removed or sepsis if any was established. Out of hundred clean major operations were studied bacteriologically in an attempt to locate the source of any subsequent staphylococcal infection of wounds or drains. There were 12 cases of septic infection and 13 of non-septic infection. The majority of both of these types of infection appeared to have arisen in the ward.

In 1969, Everett et al (16) conducted a prospective study to determine whether results of colonic surgery differed after preparation of the large bowel with and without antibiotics. Patients undergoing surgery for diverticulitis, carcinoma or ulcerative colitus were selected. Patients with acute obstruction were not included. All patients were divided by random selection into two groups - A & B. Patients in Group A were prepared for operation by lavage and by administration of oral neomycin 1 gm. 4 hourly, those in group B were prepared by lavage only. The operations were carried out by seven surgeons. Anastomosis were performed by all these surgeons by the open method in two layers using inner continuous OO chromic catgut and outer interrupted silk sutures. Forty five of the 50 patients came to operation of whom 10 were judged to be in a state of incomplete obstruction per-operatively. In 39 of the operations it was possible to inspect the whole colon. No difference was noted in the quantity and quality of the bowel contents between patients

of neomycin treated group (A) & group receiving only levage (B). In post-operative period, wound infection generally yielded a mixed flora with E. coli predominating. Evidences obtained that wound infection resulted from implantation of gut organism into the neighbouring tissues at operation. It was suggested that a reappraisal of aseptic technique at operation might favour a great reduction in wound sepsis in colonic surgery than pre-operative administration of oral antibiotics.

The rising tempo with which anerobes were being recovered from infected patients demanded a heightened awareness of the role these organisms play in human sepsis. Practically all anaerobes infecting human tissue can be isolated from the microbial flora of the normal intestinal tract in which anaerobic conditions prevail. The fact that most gram positive anaerobes are sensitive to penicillin probably accounts for their rare association with significant human infections.

In 1973 Eugene R. Nobles (19) studied bacteroides infections in one hundred and twelve patients at Baptist Memorial Hospital, Memphis. Out of 112, 43 had septicaemia and 69 had soft tissue infection. Median age of patients was 48 year with the range between 7 and 83. To isolate and identify anaerobes they used the method of Holdeman & Moore. They routinely innoculated into thioglycollate broth all materials suspected of containing anaerobes. This included

all specimens of blood, wound exudates and body cavity fluids. B. fragilis was by far the most common species recovered in 43 patients with septicaemia. These organisms were the solitary blood isolate in 37 patients, 15 of whom died. The B. fragiles again dominated in bacterial flora recovered in 69 instances of soft tissue infection. The portal of entry or primary focus of infection in the 43 cases of septicaemia was G.I.T., Urinary tract & lungs. Six of the eight patient died in whom the lung was the primary focus of infection. The 43 patients with bacteroides septicaemia demonstrate the full potential of these organisms for serious, frequently lethal infections. Out of 43 patients, with positive bacteroides blood culture, 15 died, a mortality of 35%. Disseminated, intravascular coagulation was present in 5 patients, one of whom died. Septic shock occurred in 7 patients, six of whom died.

Sixty nine patients developed localised areas of infection from which bacteroides species were cultured, often as solitary isolate. Forty nine of these infections were abscesses, five were generalised peritonitis, three were anaerobic cellulitis, three were urinary tract infections, two were endometrial infections, one was a decubitus ulcer and one was severe gastro-enteritis.

Of those with septicaemia who received no effective antibiotic 60% died, although only 12% died who were treated with any appropriate drug. Their antibiotic studies revealed

chloramphenicol, clindamycin and carbenecillin to be the most effective antimicrobials.

In 1976 Maj Kumar & A.A. Mittal (39) studied the role of prophylactic antibiotics in post-operative wound infections at M.G. Institute of Medical Sciences, Wardha. A total of 698 patients admitted under a single surgeon over a period of 2 years formed the basis of study. Patients operated for infected conditions or admitted with infected wounds have been excluded. The patients included in the study were divided into clean and potentially infected cases. The clean cases were further subdivided into two groups. In one, no antibiotics were given whereas patients in the other group received prophylactic antibiotics in the post-operative period. All cases in potentially infected group received a course of antibiotics in post operative period. A careful inspection of the operation wound was done at frequent intervals in the post operative period. Whenever there was evidence of infection, including a stitch abscess, samples were taken for bacteriological study. A total of 393 clean cases were operated without any post-operative antibiotics. 27 of these cases developed wound infection, 5 being bacteriologically sterile giving an overall sepsis rate of 6.9% and a purulent infection rate of 1.51%. 195 clean cases were given prophylactic antibiotics (Penicillin and streptomycin) for a period of 5 days after operation.

Thirteen of these cases developed infection, one of which was bacteriologically sterile giving an overall sepsis rate of 6.6% and purulent sepsis rate of 6.1%. A total of 110 potentially infected cases were given a combination of penicillin and streptomycin or a broad spectrum antibiotic for a period of 5-7 days after operation. 10 of these cases developed wound infection, two being sterile, giving an overall infection rate of 7.3%. So in this study, the overall infection rate was 7.1% and a purulent infection rate was 6%. The predominant organism grown from infected wounds in clean surgical procedures was coagulase positive staphylococcus aureus, which was resistant to the commonly used antibiotics in about 25% cases. No significant difference in the infection rate has been found in clean cases treated with or without antibiotics. They concluded that in clean operative procedures unless there are specific indications it is better to administer appropriate chemotherapy after bacteriological study of the infected wound rather than routinely used prophylactic antibiotics.

Pseudomonas aeruginosa is a common isolate of surgical wound infection. Due to its resistance to commonly used antimicrobials and difficulties in its eradication from the environment because of its ability to multiply in presence of even trace amounts of nutrients and its ability to survive for long in most environment, hospital acquired infections with P. aeruginosa is a

common finding in surgical wards. In 1979 Sen Gupta (41) isolated 160 samples of P.aeruginosa out of 5309 clinical samples from different clinical disciplines of general hospital at Dr. V.M. Medical College, Solapur, Maharashtra. Majority of them were from pus and urine samples refered from burn patients and post-operative patients of surgical wards. Hence an epidemiological study of these surgical wards was conducted to determine the source and amount of colonisation of P. aeruginosa in these wards.

A total of 840 samples consisting of skin, nails, nose and throat swabs to detect P. aeruginosa carriers from surgical ward staff and patients, swabs from walls, floors, beds, equipments and furnitures of these wards to detect environmental contamination with P. aeruginosa and 1% Dettor nutrient agar plates were exposed to air for 1 hour at different sites of these wards to detect serial contamination with P. aeruginosa were collected. Cotton wool swabs soaked in glucose broth were used for swab collection and 1% DNA was used as a selective medium for isolation of P. aeruginosa. Eight hundred and forty epidemiological samples from surgical wards where incidence of P. aeruginosa, isolation was noted to be higher, yielded twenty P. aeruginosa strains.

In 1979 M.R.S. Keighley (29) conducted a prospective randomised trial in 93 patients undergoing elective colorectal operations were given a short

prophylactic course of metronidazole and kanamycin orally or systemically. Post-operative sepsis occured in only 3 (6.5%) of those given antimicrobials systemically compared with 17 (3.6%) of those given oral prophylaxis. 15 of the 17 infections in patients who received antimicrobials orally were due to kanamycin resistant bacteria present in the colon at operation. Bacterial over-growth of staph. aureus was recorded in 6 of the patients who received oral therapy. These results indicated that oral administration of prophylactic antimicrobials in colon surgery should be avoided because of risk of bacterial resistance, superinfection and antibiotic associated pseudomembranous colitis. Systemic pre-operative antimicrobials prophylaxis is safer and more effective.

In 1980 T.J. Bucknall (10) studied the effect of local wound infection upon wound healing. It was an experimental study. Local infection was introduced into rat abdominal wounds using a 10^8 bacteria/ml inoculum. Three groups of infection were used. Staphylococcus aureus, pseudomonas aeruginosa and a combination group of E. coli and proteus mirabilis. Infection was shown to delay healing as judged by bursting tests. Fibroblast proliferation was depressed at wound edges but there was an increase in the total amount of hydroxyproline present. Small vessels angiogenesis was increased in areas of abscess formation but larger vessels were commonly blocked by thrombus or distorted by surrounding inflammed tissue.

The advent of antibiotics did raise the hope of a permanent solution, but later it has became the nightmare of the surgeons. Many considered and still now consider antibiotics as 'wonder drugs' which could cover their lapses in surgical techniques and asepsis. Over reliance on antibiotics led to their extensive and often indiscriminate use resulting into development of resistance by various organisms. Similarly too much reliance was placed on conventional dressings. In 1981, Lt. Col. T.K. Cherian(12) studied prospectively 408 surgical cases to see whether the use of prophylactic antibiotics and conventional dressings could be dispensed within the majority of clean and clean contaminated cases.

Four hundred and eight consecutive clean and clean contaminated cases operated by Lt. Col. T.K.Cherian(12) during 5 year period were included in this series. In group I of clean cases there were 226 patients whereas in group II, of the clean contaminated cases there were 182 patients in whom either the gastro-intestinal tract or the biliary tract was opened. In this series of 408 cases, 61 cases (14.95%) developed wound infection, out of which 26 occured in clean group (11.50%) and 35 in clean contaminated group (19.23%). It was observed that the infection rates were higher when prophylactic antibiotics and conventional dressings were used. The commonest organism found in the series was staph. pyogenus.

The others were C. coli and pseudomonas pyocyaneus. All these were resistant to majority of antibiotics commonly used.

It is frequently said and with some truth that you cannot begin to investigate something until you can measure it. There is no doubt, for instance, that the clinical study of accidental trauma has greatly depended on the various attempts to grade its severity (21, 22). The introduction of the injury severity and case system by Baker et al (3) represented a big advance for detailed studies on many aspects of trauma (11, 49, 56) then became possible. Many of pathophysiological and metabolic consequences of sepsis, particularly that in the abdomen and thorax resemble those after accidental trauma. Further work is being hindered by the lack of a convenient grading system since at present it is difficult to compare findings in different patients or different centres. The most developed system for classifying patients with sepsis was that devised by Sigel et al (1979) (45), using a number of cardiovascular parameters, not all of which are easily obtained. Despite the value of this method something simpler was needed which could be applied at a district general hospital level and yet which could still be more sensitive than a simple 0-10 scale.

E.A. Elebute & H.B. Stoner (17) in 1983 tried to develop a grading system which met these requirements.

In this system four classes chosen for grading the severity of sepsis were local effects of sepsis, pyrexia, secondary effects of sepsis and laboratory data. This grading system was applied to 15 patients. Five of these patients died and in 4 of them the highest score exceeded 20 whereas in the patients who survived, the score only rose above 20 in one.

In 1983 Lawrence Z. Stevens (47) developed a method for scoring the severity of a septic process, based on deteriorated functions in seven key organ systems of the body. The scoring system was numeric and recognized that the risk to a patient rises geometrically as organ system functions deteriorate step by step. The scoring system was validated by reviewing the clinical course of 30 patients with sepsis. Prognosis and hospital stay correlated well with individual scores. The scoring system offered more accurate comparison in clinical studies of infected patients and helped follow-up a patient with sepsis more accurately. To arrive at a score for a given patient with sepsis, each of several vital organ system was assigned a numeric value based on the physiological and clinical data available.

Each of seven systems (lung, kidney, coagulation, cardiovascular, liver, gastro-intestinal tract, neurologic) was graded in 36 patients with severe sepsis and assigned a number from one to five, according to the severity of

the dysfunction in the organ system. They applied the scoring system prospectively to evaluate its prognostic accuracy and utility. Each patient had a septic source that could be improved by drainage or debridement thus was defined as having surgical sepsis. The source of infection was shown in each case at operation or autopsy. Also each patient had one or more failed organ systems. Any patient scoring less than 6 with the system was not included in the study. Scores were calculated by squaring the assigned values given to each of the three organ systems with the most severe dysfunction and adding these three highest scores to arrive at a final rating. Thus if a patient was observed to have septic shock requiring vaso-pressins, required mechanical support for respiration and had a serum creatinine level of 2.9 mg/100 ml, the sepsis severity score (SSS) would be calculated as $4^2 + 4^2 + 2^2$ for a total score of 36 ( ). The survival of a patient was compared with the individual SSS at the time of surgical effort. The mean SSS in the patient who died was 49 and that for survivors 29, indicating that the SSS correlated with the prognosis for a given patient. When the length of hospital stay for survivors was compared with their SSSs, high scores were noted for patients with longer hospital stay.

The system was found to be efficient, with rating of a new patient requiring only an average of five minutes

for a physician familiar with the system who used the scoring system. An SAS value of 6 or greater, however seemed to signal a level of severity that warranted supervision in an intensive care unit.

The introduction of antiseptic principle in surgical practice revolutionized the scope of surgery. Since then many advances that have been made in asepsis and antisepsis have considerably reduced the hazards of infection of surgical operations. Despite all these advances, wound infection still remains one of the important causes of post-operative morbidity in the hospital. In 1985, S.S. Kowli & R.A. Bhalerao (30) conducted a study to find out the post-operative infection rate in Seth G.S. Medical College & K.E.M. Hospital, Parel, Bombay, the probable source of infection, the type of bacteria most commonly involved, their antibiotic sensitivity pattern and other common factors contributing to post-operative sepsis.

During the 3 year period from June 1982 to May 1985, a total of 1034 cases were operated upon at the K.E.M. Hospital and 85 cases were operated upon at the Community Health Centre, Malavan, Bombay by a single surgical unit. Details of patients age, sex, diagnosis, nature of operation, pre-operative stay, post-operative stay, duration of operation & post-operative course were

carefully noted. A wound was considered to be infected either when pus was present or micro-organisms were grown in conjunction with signs of inflammation.

One hundred fifty cases studied at K.E.M. Hospital were divided into elective (n = 129) and emergency (n = 21) cases. The elective cases were further classified into routine major (n = 24) and routine minor (n = 35). Each patient was studied for pre-operative, intra-operative and post-operative bacteriological investigations. Pre-operatively, nasal throat and rectal swabs and urine cultures were taken. During operation, air sampling of operation theatre was done by sedimentation plate technique. Incision site swab was taken from subcutaneous area of the wound just before the final skin closure. Post-operatively intravenous catheter tips, urine catheter tips were evaluated for their bacteriology in all patients. In the case which showed clinical evidence of post-operative infection, wound swabs, peritoneal fluid, pus and blood were also studied for their bacteriology.

Results - It was noted that infection rates were not related to the sex of the patient. The infection rate was greater in patients beyond 50 years (21 out of 28) compared to that in the patients $\leq$ 50 years of age (49 out of 122).

- Pre-operative stay beyond 7 days in the hospital increased the post-operative infection rate by a multiple of 4.

- The infection rates for clean and unclean cases were 44 out of 117 (37.6%) and 10 out of 12 (83.4%) respectively.

- Post operative wound infection was found in 70 out of 150 patients and 85 wound swabs were taken for study Out of 85 swabs, only a single gram positive organism (staph aureus & albus) was grown in 9 swabs. Single gram negative organism (E. coli, klebsiella, proteus pseudomonas) accounted for 14 swabs (17%).

In this study the infection rate was directly proportional to the pre-operative hospital stay and duration of operation. The infection rate was 37.6% for clean cases and 83.4% for unclean cases. Bacillus subtilis was the predominent organism in the theatre environment. The overall infection rate at K.E.M. Hospital, was 42%. 11.4% for routine minor, 46.3% for routine major and 76.2% for emergency cases. At KEMH 69% of the infecting organism were from endogenous source and all such organisms were gram negative bacilli. Gram negative aerobic bacilli and gram positive aerobic cocci were isolated in 45.6% & 10% post-operative wound swabs respectively. At KEMH 23% anaerobes along with gram negative bacilli - Bacteroid species accounting for 49.6% - were also isolated in post-operetive wound swabs. Gentamicin was the antibiotic to which the isolated aerobes were most sensitive - 98% at

KPM. No clean case died of mixed gram negative bacilli and anerobic infection.

Despite the advances made in pre-operative asepsis, antiseptic techniques and prophylactic antibiotics, the incidence of post-operative wound infection is quite common. In 1965, Khan (26) et al conducted a study to see the problem of post-operative wound infection in reference to various factors directly or indirectly related in wound infection in J.N. Medical College Hospital, Aligarh, U.P.

A total of 456 patients admitted under a single surgical unit formed the basis of study. Patients operated for infected conditions were excluded and only those with clean wounds were studied. Each patient was followed up from the time of admission till the discharge from the hospital and then upto 2 months after discharge. When infection was suspected, a sterile cotton swab was dipped directly into the infected wound and a primary culture was done. If the culture turned out to be positive then the antibiotic sensitivity was also performed using the standard perfusion method.

Out of 450 patients studied, 359 (79.8%) had their wounds healed by first intention, 91 cases developed post-operative clinical as well as bacteriological wound sepsis. The infection rate was also higher in females (30 out of 114 - 27.3%) as compared to 61 out of 336 males (18.1%). The

highest infection rate was observed in simple mastectomies and lowest in herniorrhaphies and lumbar sympathectomies. The infection rate was higher in cases where drains were used (63 out of 209 cases - 30.1%) as compared to 28 out of 241 - 11.6%) where drain was not used. Pre-operative hospital stay showed no relation to the post-operative wound infection. Various predisposing factors responsible for post-operative wound infection were anaemia, malignancy and remote infections. Diabetes, dehydration, infected urine and previous admissions/operation did not contribute at all to the infection.

A total of 79 cultures were examined for the presence of micro-organisms. Of these, 43 (54.4%) showed staphylococci, 15 (18.9%) showed E. coli, 11 showed pseudomonas, 19 showed proteus, one showed Klebsiella and one showed streptococcus haemolyticus.

Although lot of work was done in exogenous sources, only a few reports of endogenous (self infection) wound infection and that too due to Staph. aureus associated with skin carriage were available. Self infection did not seem to play an important role in infection caused due to Pseudomonas aeruginosa. However, role of auto-infection in the etiology of wound infection due to other infecting organisms was not been thoroughly investigated. A study was therefore carried out by Ashok Kumar (32) in A.I.I.M.S., New Delhi in 1985, to determine the role of auto-infection

in the causation of surgical wound infection. Swabs from nose, throat, skin and high rectal swabs were taken 12 - 24 hours prior to surgery. Patients included in this study were divided into different groups - clean, clean contaminated and dirty wounds. Wound swabs, stitch or a piece of drain was obtained in the post-operative period at the time of shortening the drain and on 3rd, 5th & 7th day. Out of 100 indoor patients who underwent elective surgery, 64 were found to be carrier of a single/multiple pathogenic organisms at one or more sites pre-operatively. Post-operatively, 20 patients developed wound infection, while pathogenic organisms were found to colonise wounds of 14 more patients. Fifteen carriers developed wound infections/ colonisation in the post-operative period due to the same organism as carried by them during the pre-operative wound. A total of 5 patients developed wound infection due to Staph. aureus in the post-operative period. Klebsiella pneumoniae was isolated from the wounds of 8 patients who developed wound infection. In total auto-infection occured in 2 of the 20 patients who developed wound infection in post-operative period. One of these was due to Staph. aureus and other due to proteus. Auto-infection therefore plays a minor role, if at all, in the etiology of wound infection.

Progress in the study of sepsis had been hampered by the lack of a suitable system for grading its severity.

Systems suggested for scoring sepsis have been based either on its systemic effects (APACHE II) (27) or on a mixture of local and systemic variables (sepsis score) (17). In 1987, G.A. Fanling, M.A.F. Dudley and A.J.W. Sim (38) conducted a prospective study on 45 patients of sepsis and compared the local and systemic effects of sepsis in predicting survival. The APACHE II (27) and sepsis scores were applied to patients with intra-abdominal sepsis of more than 3 day's duration to determine if local or systemic factors were more important in predicting survival. Of 45 patients studied, 14 died. The sepsis score for non-survivors (median 21.5, range 11-32) was significantly higher than for survivors (median 14, range 10 - 26). There was overlap between the two groups, such that an individual score had no predictive value. The local component of the sepsis score was not significantly increased in non-survivors but the systemic component was. The APACHE II score for non-survivors (median 24, range 15-38) was significantly higher than for survivors (median 12, range 3-21) and correctly identified 13 of the 14 fatalities. Both the systemic and non-systemic components (age and chronic disease) were significantly higher among the latter. The APACHE II was more effective than the sepsis score in predicting survival.

In 1988, Rohman et al (7) conducted a prospective study in cases of abdominal sepsis and applied APACHE II

scoring system (Acute Physiology and Chronic Health Evaluation). They correlated APACHE II scores with mortality in 100 patients hospitalised for generalised peritonitis or abdominal abscess. Use of steroids was recorded because of suspicion that steroids increase mortality but slow the physiologic response to sepsis. They studied 51 males and 49 female patients. The mean age was 58.8 years. Thirty one patients died and a total of 129 episodes of abdominal sepsis occured. Nineteen patients received long term steroid therapy and a total of 25 patients received steroids at any time.

Overall, the mean APACHE II score in 100 patients was 13.72 with a range from 0 to 36. The mean APACHE II score in patients who died was 18.9 compared with 11.4 in survivors. An increasing APACHE II score was associated with an increased likelihood of mortality. The mean APACHE II score of 12 patients receiving long term steroid therapy but who died was 17.5, compared with a mean APACHE II score of 13, in seven survivors receiving long term steroid therapy. Step-wise discriminant analysis revealed that the APACHE II score and steroid use were significantly and independently associated with survival.

The role of anaerobic bacteria in post-operative sepsis, is well known. In 1989 Thangam Menon (36) from

post-graduate Institute of Basic Medical Sciences, Madras conducted a study to find out the incidence of anaerobic in various post-operative infections and the antibody response in these patients using counter immuno-electrophoresis (CIEP) and agglutination tests.

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MATERIAL AND METHODS

MATERIAL AND METHODS

During one year period from May 90 to May 91 a total of 1000 cases were studied. These patients were admitted to M.L.B. Medical College, Jhansi, for any surgical interventions. Details of the patient's age, sex, diagnosis, nature of operation, post-operative stay and post-operative course were carefully noted.

When infection was noticed or suspected, a sterile cotton swab dipped directly into infected wound and sent for culture to identify infective organism. At the same time, scoring of sepsis was done by modified scoring system (R.A. Kiebuto & M.B. Stoner) (17). In this system four classes of attributes of sepsis were choosen. They were as follows -

a) Local effects of sepsis,
b) Pyrexia,
c) Secondary effects of sepsis,
d) Laboratory data.

a) Scoring of local effects of tissue infection -

I. Wound infection with purulent discharge/entero-cutaneous fistula.

(i) requiring only light dressing changed not more than once daily — 2

(ii) requiring to be dressed with a pack or dressing needing to be changed more than once daily or requiring application of a bag or requiring suction. — 4

II. Peritonitis

(i) localised peritonites — 2

(ii) generalised peritonites — 6

III. Chest infection :

(i) Clinical or radiological signs of chest infection without productive cough — 2

(ii) Clinical or radiological signs of chest infection with a cough producing purulent sputum — 4

(iii) Full clinical manifestation of lobar/bronchopneumonia — 6

IV. Deep seated infection (subphrenic abscess, pelvic abscess, empyema, thoracic, acute or chronic osteomyelitis.

b) Scoring of Pyrexia :

Maximum daily temp.	Score
36.0 - 37.4°C	0
37.5 - 38.4°C	1
38.5 - 39.0°C	2
7 39°C	3
∠ 36°C	3
Minimum daily temp. 737.5°C	Add 1
If 2 or more temp. peaks above 38.4°C in one day	1
If any rigors occur in a day	1

c) Scoring of secondary effects of sepsis :

While it was possible to define gradations of the local effects of tissue infections, pyrexia, laboratory data, the attributes listed as secondary effects can not be so graded, therefore they were treated as existance criteria and given score if present.

i) Obvious jaundice (in the absence of established hepatobiliary disease	2
ii) Metabolic acidosis -	
(a) Compensated	1
(b) Uncompensated	2

iii) Renal failure 3

iv) Gross disturbance of mental orientation/level of consciousness (e.g. delirium, comma) or other focal neurological manifestation of pyaemia/septicaemia 3

v) Bleeding diasthemes (clinical basis) 3

d) Scoring of Laboratory data :

i) Hb level in the absence of obvious bleeding -

(a) 7 - 10 gm% 1

(b) < 7 gm% 2

ii) Leucocyte count (10^9/L)

(a) 12 - 30 1

(b) > 30 2

(c) < 25 3

iii) Platelet count ($x10^9$/L)

(a) 100 - 150 1

(b) < 100 2

iv) Plasma albumin level (g/L)

(a) 31 - 35 1

(b) 25 - 30 2

(c) < 25 3

v) Plasma total bilirubin level in the absence of clinically obvious jaundice

7 25 u mol/L 1

vi) Blood culture -

(a) Single positive culture 1

(b) Two or more positive culture separated by 24 hr. 3

This scoring system of sepsis was applied to patients in which sepsis was noted in the post-operative period upto the time of discharge. For scoring of sepsis each attribute was scored separately and sum of all scores gave an aggregate criterion which represented the total effect of septic state of the patient.

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OBSERVATIONS

OBSERVATIONS

A total of 1000 cases were studied from May 1990 to May 1991 in the Department of Surgery and Department of Obst. & Gynaecology in M.L.B. Medical College, Jhansi. Attempt has been made to include all major cases operated during one year period, however, few cases could not be included because of incompleteness of study due to unavoidable reasons. In this study, we have excluded cases of fissure in ano, fistula in ano and haemorrhoidectomy because in previous such studies regarding hospital sepsis, these cases were not studied.

Each patient was followed-up from first post-operative day till the discharge from the hospital. Age and sex distribution of total cases is shown in Table 1 & 2.

TABLE 1

Distribution of the cases by age.

Age group (years)	Total No.of cases	Percentage
0 - 9	68	6.8
10 - 19	73	7.3
20 - 29	315	31.5
30 - 39	194	19.4
40 - 49	160	16.0
50 - 59	94	9.4
60 - 69	70	7.0
70 - 79	32	3.2
7 80	14	1.4
Total	1000	

TABLE 2

Distribution of cases by sex.

Sex	No. of cases studied	Percentage
Males	573	57.3
Females	427	42.7
Total	1000	100.0

M:F = 1 : 1.34

Total number of cases studied were divided into 3 groups - Clean, clean contaminated, and infective (Table 3).

TABLE 3

Distribution of cases by type of surgery.

Type of Surgery	No.of cases	Percentage
Clean	605	60.5
Clean contaminated	214	21.4
Infective	181	18.1
Total	1000	100.0

Number of cases included in 3 groups depending upon the type of surgical procedure is shown in table 4, 5 & 6.

TABLE 4

Distribution of cases in "clean" group as per operative procedure.

Name of operation	No. of cases	Percentage
Herniorrhophies	80	13.22
Cholecystectomies	46	7.60
Hystrectomies	145	23.96
Caesarean sections	221	36.52
Oophrectomies	20	3.30
Exploratory Laprotomies	2	0.33
Mastectomies	7	1.15
Cleft lip repair	11	1.81
Thyroidectomies	5	0.82
L. sypathectomies	9	1.48
Excision of breast limp	12	1.98
Miscellaneous	47	7.76
Total	605	100.00

TABLE 5

Distribution of cases in "clean contaminated" group as per operative procedure.

Type of operation	No.of cases	Percentage
Prostatectomies	95	44.39
Pyelolithotomies	40	18.69
Nephrectomies	4	1.86
Cystolithotomies	38	17.75
Ureterolithotomies	9	4.18
Appendisectomies	28	13.08
Total	214	100.00

TABLE 6

Distribution of cases in "Infective" group as per operative procedure.

Name of operation	No.of cases	Percentage
Enteric perforation	39	21.54
Intestinal obstruction	62	34.25
Ectopic pregnancy	2	1.10
Intussusception	4	2.20
Gastric perforation	1	0.55
Obstructed Hernia	9	4.97
Faecal fistula	1	0.55
Stab wound abdomen	12	6.62
Duodenal perforation	6	3.31
Jejunal perforation	6	3.31
Sigmoid volvulus	12	6.62
Burst liver abscess	1	0.55
Ac. Pancreatitis	1	0.55
Ischaemic colitis	6	3.31
Gun shot wound abdomen	10	5.52
Appendicular perforation	9	4.97
Total	181	100.00

Out of 1000 cases studied, 96 cases developed clinical as well as bacteriological wound sepsis (Table 7).

TABLE 7

Overall Infection rate.

Total No.of cases studied	No.of cases infected	Percentage
1000	96	9.6

Out of 96 infected cases, 95 cases showed bacteriological wound sepsis. In one case pus culture taken from infected wound was sterile. In 90 cases, single bacterium was responsible for causing sepsis while in remaining cases more than one bacterium namely Klebsiella, E.coli, Staph. aureus and proteus were responsible for causing sepsis (Table 8).

TABLE 8

Types of bacteria cultured.

Name of bacteria	No. of cases	Percentage
Staph. aureus	40	41.67
Klebsiella	20	20.83
E. coli	19	19.79
Proteus	7	7.29
Enterobacter	4	4.17
Mixed culture	5	5.21
Sterile culture	1	1.04
Total	96	100.00

For scoring of post-operative wound sepsis grading system of P.A. Plebute (17) was applied to all 96 infected cases and highest sepsis score during the period of study was noted in all cases. Different score in these patients is shown in Table 9.

TABLE 9

Scoring of sepsis.

Highest sepsis score	No.of cases	Percentage
0 - 4	19	19.79
5 - 8	35	36.45
9 - 12	39	40.62
13 - 16	3	3.12
Total	96	100.00

For observation of morbidity, we considered total post-operative stay in the hospital (Table 10).

TABLE 10

Overall morbidity.

Hospital stay	No. of cases	Percentage
< 10 days	868	86.8
> 10 days	132	13.2
Total	1000	100.0

In our study, out of 1000 cases, 6 patients died. Out of 6, one patient was from clean group and rest of 5 were from infective group (Table 11).

TABLE 11

Overall mortality.

Type of cases	No. of deaths	Percentage
Infected - 96	5	5.20
Non-infected - 904	1	0.11
Total 1000	6	

$t = 6.38$, $P < 0.001$

Correlations

In this study, when correlation of infection with different age groups was done, then it was found that infection rate was slightly higher in older age group as compared to children (Table 12).

TABLE 12

Infection rate in various age groups.

Age group (years)	Total No. of cases	No. of cases infected	Percentage
0 - 9	48	2	4.16
10 - 19	73	8	10.95
20 - 29	315	32	10.15
30 - 39	194	15	7.73
40 - 49	160	17	10.62
50 - 59	94	10	10.63
60 - 69	70	5	7.14
70 - 79	32	4	12.50
7 80	14	3	21.40
Total	1000	96	9.6

X^2 = 3.61, d.f. = 6, P 70.70

Infection rate was slightly more common in males as compared with females (Table 13).

TABLE 13

Infection rate by sex.

No.of cases studied	No. of cases infected	Percentage
Males - 573	56	9.77
Females - 427	40	9.36
Total 1000	96	9.6

$x^2 = 0.05$, d.f. = 1, $P > 0.80$

As far as type of surgery was concerned, infection rate was highest in infective group and lowest in clean group (Table 14).

TABLE 14

Infection rate in various groups of surgery.

Type of Surgery	No.of cases studied	No.of cases infected	Percentage
Clean	605	35	5.78
Clean contaminated	214	21	9.81
Infective	181	40	22.00
Total	1000	96	9.6

$x^2 = 45.18$, d.f. = 2, $P < 0.001$

In clean group of surgery, maximum infection rate was observed in mastectomies and lowest in herniorrhaphies (Table 15).

TABLE 15

Infection rate in clean group.

Type of operation	No.of cases studied	No.of cases infected	Percentage
Herniorrhaphies	80	2	2.50
Cholecystectomies	46	2	4.34
Hystrectomies	145	12	8.27
Caesarean section	221	14	6.33
Nephrectomies	20	-	-
Exploratory laprotomies	2	-	-
Mastectomies	7	2	28.57
Cleft up Repair	11	-	-
Thyroidectomies	5	-	-
L. Sympathectomies	9	2	22.22
Excision of breast lump	12	-	-
Miscellaneous	47	1	2.12
Total	605	35	5.78

In clean contaminated group, highest infection rate was observed in nephrectomies and lowest in ureterolithotomies (Table 16).

TABLE 16

Infection rate in clean contaminated group.

Type of operation	No.of cases studied	No.of cases infected	Percentage
Prostatectomies	95	13	13.68
Pyelolithotomies	40	4	10.00
Nephrectomies	4	1	25.00
Cystolithotomies	38	3	7.89
Ureterolithotomies	9	-	-
Appendicectomies	28	-	-
Total	214	21	9.81

In infective group, highest infection was observed in faecal fistula repair and lowest in intestinal obstruction (Table 17).

TABLE 17

Infection rate in infective group.

Type of operation	No.of cases studied	No.of cases infected	Percentage
Enteric perforation	39	11	28.20
Int. obstruction	62	11	17.74
Ectopic pregnancy	2	-	-
Intussusception	4	-	-
Gastric perforation	1	-	-
Obstructed Hernia	9	1	11.11
Faecal fistula	1	1	100.00
Stab wound abdomen	12	2	16.66
Duodenal perforation	6	4	66.66
Jejunal perforation	6	-	-
Sigmoid volvulus	12	4	33.33
Breast liver abscess	1	1	100.00
Ac. pancreatitis	1	-	-
Ischaemic colitis	6	-	-
Gun shot wound abdomen	10	4	40.00
Appendicular perforation	9	2	22.22
Total	181	40	22.00

When analysis of scoring in relation to type of surgery was done, by dividing all infected patients into two groups with highest sepsis score 0-8 and 9-16, maximum number of patients were from infective group with 9-16 scoring (Table 18).

TABLE 18

Distribution of scoring by type of surgery.

Highest sepsis score	Type of surgery			Total
	Clean	Clean contaminated	Infective	
0 - 8	25	7	22	54
9 - 16	10	14	18	42
Total	35	21	40	

$X^2 = 7.82$, d.f. = 2, $P < 0.05$

We analysed the post-operative hospital stay in relation to sepsis scoring and it was statistically insignificant (Table 19).

TABLE 19

Distribution of scoring by hospital stay.

Highest sepsis score	Post-operative hospital stay			Total
	< 10	10 - 20	> 20	
0 - 8	8	36	10	54
9 - 16	2	30	10	42
Total	10	66	20	96

χ^2 = 2.65, d.f. = 2, P > 0.20

When overall mortality was analysed in relation to sepsis scoring, it was found to be little more in patients with sepsis score 0-8 as compared to patients of sepsis score 9-16 (Table 20).

TABLE 20

Overall mortality by sepsis score.

Highest sepsis score	No. of cases	No. of deaths	Percentage
0 - 8	54	3	5.55
9 - 16	42	2	4.76
Total	96	5	5.20

t = 0.17, P > 0.80

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D I S C U S S I O N

DISCUSSION

Post-operative wound infection is designated to one of the three categories.

1. Inapparent (infection present without disease).

2. On admission (infection present on admission).

3. Hospital acquired (nosocomial) - one that develops within the hospital or is produced by micro-organisms acquired during hospitalization (8).

Organisms that cause nosocomial infection come from either endogenous or exogenous sources. Endogenous infections are caused by patient's own flora whereas the exogenous infections result from transmission of organisms from a source other than the patient.

The post-operative wound infection rate as reported by various workers in the literature varies from 1.8% to as high as 55.6% (2, 5, 25, 53). Public Health Laboratories service (37) reported sepsis rate in different hospitals of England & Wales undertaking general surgery 4.7 to 21.8%. Lawrence S. Cohen (13) reported 16% post-operative infection rate in his study while John S.S. Stewart (46) reported 1.8% post-operative wound sepsis rate. In 1964, Committee

on trauma (14) published a report on post-operative wound infection and it varied from 3 - 11% in different hospitals. S.S. Kowli et al (30) reported 42% post-operative infection rate, while M.A. Khan reported it 20.2%.

In present study the overall incidence of post-operative wound infection was 9.6%, which is fairly compatible with previous studies.

The post-operative wound infection rate depends upon large number of factors like longer the pre-operative stay greater was the incidence of post-operative wound infection shown by many authors (30, 37, 40, 57). Longer the duration of operation, greater the incidence of post-operative wound infection shown by Wasek, Venkataraman & Public Health Laboratories report (37, 54, 55). In contrast to these, Shaw et al (43) reported that post-operative wound sepsis is not dependent on the duration of operation and stated that different operations had their own infection rates decided mainly by the endogenous factors. Howe (24) suggested that any breach of asepsis in the operation theatre is responsible for high infection rate.

Rao, Marsha, Stewart & Douglas (40, 46) observed lowest infection rate in cases kept first in the operation list. Endogenous micro-organisms were suggested by

Kimmelman et al (28) and Story (52) as a cause of post-operative wound infection. However, our study was not aimed to see the effects of all above factors, hence they have not been worked out.

In our study post-operative wound infection rate was slightly higher in males as compared with females. Out of 573 males, 56 (9.77%) developed post-operative wound infection and 40 females out of 427 (9.36%) developed infection. However, this difference was found to be statistically insignificant ($P > 0.80$). Cohen et al (13) reported the same findings while others have reported higher infection rate in females in their studies (9, 14, 33, 37).

The post-operative infection rate was apparently higher (21.4%) in older age group (> 80 year) in our study. However, this was again found to be statistically insignificant ($P > 0.70$). So in our study, age of the patient had no bearing on the post-operative wound infection. Brune (9) and Lidwell (33) have also considered age as an independant factor. While some worker (14, 37) have reported higher infection rate in older age group.

Infection rate was highest in infective group (22%) and lowest in clean group (5.78%). High infection rate in infective group was found to be statistically significant ($P < 0.001$). Similar findings have been reported by other workers also (39, 12, 30).

The post-operative wound infection was highest in simple mastectomies and lumbar sympathectomies and lowest in herniorrhophies. Increased rate of infection in mastectomies and lumbar sympathectomies apart from other reasons could be due to use of drains in these operations. Drainage provides an outlet for collected serum and blood and prevents haematoma formation and thus it may diminish the risk of wound infection, but it is also true that drainage communicates the tissues with the exterior for a longer period and may act as a pathway for pathogenic bacteria thereby increasing the risk of infection. Lidwell (33) and Cohen (13) et al have reported a higher incidence of post-operative sepsis in drained wounds.

In our study staphylococci (41.67%) were mainly responsible for post-operative wound sepsis. Agrawal (2), Kumar (39) and others (12, 13, 23, 40, 44, 54, 55) have quoted a high staphylococcal wound infection (49.3 to 62%). Subramaniam et al (53) however reported 70% gram negative bacilli and 30% gram positive cocci from wound infection. Shaw et al (43) reported that 72.3% post-operative wound infections were due to staph. aureus. Beazley et al (6) have reported 83% mixed infection while Sten et al (48) have reported two thirds of intraperitoneal infections to be due to mixed aerobes and anaerobes. Mehta et al (35) have reported Klebsiella as predominant aerobe in perforative peritonitis. There are a number of reports

saying that in recent years, gram negative bacteria have supplanted gram positive cocci as a cause of the majority of local wound infection (4, 10, 20, 57). However, in our study gram negative bacteria were found in 52% cases.

For scoring of post-operative wound sepsis, grading system of F.A. Flebute et al (17) was applied to 96 cases. Highest sepsis score in our study was 16, while Flebute et al (17) had reported it 20 in their study. Lawrence F. Stevens (47) developed a method for scoring the severity of a septic process based on deteriorated functions in seven key organ systems of the body and the mean sepsis severity score in his study was 29 in survivors and 49 who died. Bohmen et al (7) applied APACHE II (27) scoring system in cases of abdominal sepsis. The mean APACHE II score in patients who died was 18.9 compared with 11.4 in survivors.

In all infected cases when analysis of highest sepsis score during hospital stay and type of surgery was done it was found that highest sepsis score was significantly higher in infective group of surgery ($P < 0.05$). However, duration of post-operative stay was insignificant ($P > 0.20$) in relation to highest sepsis score. So post-operative hospital stay may be increased or decreased, depending upon other factors.

As far as mortality was concerned, 6 patients died in our study. Out of 6, one patient was from clean group, a case of cholecystectomy died on second post-operative day, cause of death was more likely myocardial ischaemia, but death was not due to sepsis. Rest 5 patients were from infective group. Highest sepsis score was 16 in two patients, out of five who died and in rest of three, it was ranging from 5 to 8. High mortality in infective group was found to be statistically significant ($P < 0.001$). While overall mortality by sepsis score was insignificant ($P > 0.80$). In the study of F.A. Elebute (17), five patients died out of 25 and in 4 of them, the highest sepsis score exceeded 20, whereas in the patients who survived the score only rose above 20 in one.

This system of grading of sepsis differs from injury severity score in that it tells the severity of sepsis at a particular time whereas a patient's injury severity score remains the same throughout his course. The sepsis score can thus be used to follow the progress of a patient. This method shows a possible, simple way of grading a patient's sepsis and it has been also found very useful in the work on the metabolic aspects of sepsis (50).

At this stage, the scores alloted to various features of sepsis are largely arbitrary although their order for a particular attribute, is probably correct.

Several comments can be made on the individual gradings. The range of temperature scored above 0 is outside the normal range of 36.9 ± 0.47°C (16) and the grading of the changes in temperature has been influenced by findings of Altmeier et al (1). The inclusion and rating of metabolic acidosis reflects the work of Mac Lean et al (34). Renal failure, mental disturbance and bleeding diasthesis have been given a maximum score of 3, but with more experience, it may be necessary to increase it. The rating of thrombocytopaemia is supported by data of Kreger et al (31). The range of the laboratory tests used has been deliberately kept to a minimum of those readily available. No attempt has been made to score 'septic shock' directly because of the difficulty of getting a precise definition that would be universally accepted.

If the method is to come into general use large bodies of data should now be build up not only for thoraco-abdominal sepsis but also for sepsis in other situations such as multiple trauma and burns. This would test the general validity of the system and allow more sophisticated methods (51) to be used to determine the best values for the scores. It would also enable one to see if it was necessary to score all the attributes listed above to get a meaningful score and whether the same system was equally useful for all purposes e.g. studying the effect of age on the responses to sepsis.

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CONCLUSION

CONCLUSION

In the present study 1000 patients were followed from first post-operative day till the discharge from the hospital, to see the incidence of post-operative wound infection, type of bacteria causing infection and finally we tried to grade the severity of post-operative wound sepsis by modified scoring system of E.A. Elebute (17).

Total number of patients studied were divided into three groups according to type of surgery.

- Clean,
- Clean contaminated,
- Infective.

The conclusions derived were as follows -

1. The overall infection rate was 9.6%.
2. Staph. aureus was responsible in 41.66% for post-operative wound sepsis, while in 52% gram negative bacteria were isolated like Klebsiella, E. coli, proteus etc. and in 52% mix culture was obtained.
3. Higher post-operative infection rate in males and older age group was statistically insignificant.

4. Infection rate was significantly higher in infective group.

5. Out of 96 infected cases, maximum highest sepsis score was 16 in only three patients, two of them expired.

6. Overall mortality in our study was 0.6%.

Thus present study shows overall infection rate 9.6%, Staph. aureus responsible for post-operative wound sepsis in 41.66% with maximum highest sepsis score 16 in three patients out of 96.

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